Recent theoretical and observational developments in magnetic helicity studies

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Magnetic helicity quantifies how the magnetic field is sheared and twisted compared to its lowest energy state (potential field). Such stressed magnetic fields are usually observed in association with flares, eruptive filaments, and coronal mass ejections (CMEs). Magnetic helicity plays a key role in magnetohydrodynamics because it is almost preserved on a timescale less than the global diffusion time scale. Its conservation defines a constraint to the magnetic field evolution.

Only relatively recently, it has been realized that magnetic helicity can be computed from observations, and methods have been derived to bridge the gap between theory and observations. At the photospheric level, the flux of magnetic helicity can be computed from the evolution of longitudinal magnetograms. The coronal helicity is estimated from magnetic extrapolation, while the helicity ejected in magnetic clouds (interplanetary counter-part of CMEs) is derived through modelling the in-situ magnetic field measurements. Using its conserved property, a quantitative link between phenomena observed in the corona and then in the inter-planetary medium has been achieved.